Social Problem-Solving Abilities Predict Pressure Sore Occurrence in the First 3 Years of Spinal Cord Injury

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Objective: To test the hypothesis that social problem-solving abilities of persons with recent-onset spinal cord injury (SCI) would be predictive of pressure sore occurrence in the 1st 3 years following discharge from initial inpatient rehabilitation. Design: Prospective study of persons with recently incurred SCI and their subsequent pressure sore evaluations over a 3-year period in annual clinic evaluations. Setting: Inpatient SCI rehabilitation center and outpatient clinic. Participants: 188 persons with recent-onset SCI approaching discharge from initial inpatient SCI rehabilitation, with outpatient pressure sore evaluations for those who returned for pressure sore evaluations. Main Outcome Measure: Pressure sore occurrence as determined in annual outpatient evaluations conducted over the 1st 3 years of SCI. Results: 2 separate statistical models indicated that social problem-solving abilities significantly contributed to the prediction of pressure sore occurrence. Conclusions: Social problem-solving abilities are implicated in the development of pressure sores. Persons with ineffective problem-solving abilities may be at risk for pressure sores; these individuals might require strategic monitoring and training from clinical programs.

Keywords: social problem solving, spinal cord injury, pressure sores

Individuals who incur severe physical disabilities are at risk to develop secondary complications that compromise personal health and well-being (Rimmer & Braddock, 2002). Unfortunately, research to date has generally focused on demographic and condition-specific variables that are often of clinical interest but fall short of predictive value. Recent commentaries have recognized the deleterious impact of limited mobility, societal barriers, inadequate services, and uninformed policies on the development of preventable complications among persons with physical disabilities (Rimmer & Braddock, 2002; Yarkony & Heinemann, 1995). Yet very little research has examined the associations between cognitive–behavioral characteristics and the occurrence of secondary complications that may be mediated in part by individual activity, adherence, surveillance, and lifestyle.

Following spinal cord injury (SCI), for example, persons may develop problems with skin integrity that may ulcerate and require therapeutic intervention. Pressure sores result when blood flow to certain areas of the skin is restricted, causing the erosion of skin. This type of tissue ulceration can vary in severity, which in turn dictates the intensity of necessary treatment. Treatment for a pressure sore may be as uncomplicated as frequent pressure reliefs and restricted activity to the affected area; in contrast, severe pressure sores may require amputation of a limb or surgical skin-flap repair. Sites most prone to development of pressure ulcers are bony prominences such as the sacrum, the ischium, heels, ankles, and the trochanter. Costs (excluding physician fees) for providing care for a low-grade pressure sore exceed $17,000 (Stover, DeLisa, & Whiteneck, 1995). Unquantified indirect costs include frustration, inconvenience, interference with rehabilitation, education, vocational activities, and the strain typically imposed on immediate family (Yarkony, 1994).

Pressure sores usually occur more often among persons who have complete lesions to the spinal cord, and they are associated with longer duration of SCI and with higher levels of sensory and mobility impairment generally (Consortium for Spinal Cord Medicine, 2000). Pressure sores are considered preventable complications, because sores may develop when individuals do not adhere to recommended self-care regimens, engage in health-compromising behaviors, or lack active coping skills (Yarkony, 1994). Non-adherence to any self-care regimen is most likely to occur when adherence involves complex self-care behavior on a daily, long-term basis, with little or no observed relation to an eventual outcome (Turk & Meichenbaum, 1989). Often, individuals do not find self-care behaviors positively reinforcing given the time and effort entailed and the apparently inconsistent linkage between behavior and outcome. Nonadherence to skin-care regimens for even a brief period of time may damage skin tissue, and this in turn may perpetuate beliefs that pressure sore development is unrelated to individual choice and behavior.

Clinical guidelines maintain that pressure sores may be pre-
vented by adhering to recommended regimens for shifts in body weight (ranging from 15- to 45-min intervals to restore blood flow to constricted areas), routine skin inspections, proper nutrition and fluid intake, and avoidance of damaging stimuli (e.g., extreme heat or cold, jagged edges, ill-fitting equipment or clothing; Consortium for Spinal Cord Medicine, 2000). Prevention strategies detailed in existing guidelines emphasize education and instruction to patients and families to increase understanding, which would presumably result in adaptive behavioral changes. Yet there has been very little empirical research examining cognitive–behavioral processes in the prediction of pressure sore occurrence and prevention, and available evidence has demonstrated inconsistent associations between preventive behaviors and pressure sore occurrence (on self-report measures in cross-sectional studies; Krause & Broderick, 2004; Krause, Vines, Farley, Sniezek, & Coker, 2001). Essentially, clinical guidelines assume that cognitive–behavioral mechanisms are related to pressure sore prevention and occurrence without documented evidence that these mechanisms have been identified in prospective research and subsequently addressed in theoretically driven interventions.

Cognitive–behavioral mechanisms play an important role in the health and well-being of persons who acquire SCI (Elliott & Rivera, 2003). Problem-focused strategies may be best suited for coping adaptively with chronic, ongoing medical conditions in which persons are required to observe daily regimens for self-care while simultaneously attending to the tasks essential to the routines and roles that characterize everyday life (Elliott, Grant, & Miller, 2004). Effective interpersonal problem-solving skills have been associated with greater therapeutic adherence among families coping with chronic illness (Fehrenbach & Peterson, 1989). According to D’Zurilla and Nezu (1999), social problem-solving skills encompass the cognitive attitudes and the instrumental skills necessary for coping effectively with events encountered in daily life.

Social problem-solving abilities consist of two components—problem orientation and problem-solving styles. A positive problem orientation encompasses optimistic beliefs and a sense of competency for solving problems. Individuals who subscribe to this view often see their issues as a “challenge,” which in turn motivates them to find solutions to their problems. Research has associated this element with positive moods under routine and stressful circumstances (Elliott, Shewchuk, Harkins, & Marmarosh, 1995). Conversely, individuals exhibiting a negative problem orientation have a tendency to engage in various forms of dysfunctional cognitive styles and negative moods that impair problem solving. A negative orientation is associated with ongoing negative moods (Elliott et al., 1995), worry (Dugas, Letarte, Rheuma, Freeston, & Landoucour, 1995), health complaints (Elliott & Marmarosh, 1994; Elliott, Shewchuk, & Richards, 2001), and cognitive errors committed in a problem-solving task (Shewchuk, Johnson, & Elliott, 2000). A negative problem orientation is also predictive of depression among persons with various chronic health conditions (Elliott, Godshall, Herrick, Witty, & Spruell, 1991; Elliott, Shewchuk, Miller, & Richards, 2001; Kerns, Rosenberg, & Otis, 2002), among family caregivers of persons with disabilities (Elliott, et al., 2001; Grant, Weaver, Elliott, Bartolucci, & Giger, 2004), and among postpartum women (Elliott, Shewchuk, Richeson, Pickelman, & Franklin, 1996).

The second component of the problem-solving model focuses on the actual skills that are used to execute the process of problem solving. These skills include the ability to define a problem; generate alternatives; evaluate, implement, and monitor solutions; and make rational decisions. In times of duress, persons with more effective problem-solving skills are more likely to use problembased coping strategies (MacNair & Elliott, 1992); persons with SCI who have more effective problem-solving skills report more assertive behaviors (Elliott et al., 1991). In contrast, evidence indicates that ineffective problem-solving skills are associated with more sedentary behaviors, increased alcohol use, and an unstructured, passive lifestyle (Godshall & Elliott, 1997) and that persons with SCI who have ineffective problem-solving abilities are more likely to report health-compromising behaviors (Dreer, Elliott, & Tucker, 2004).

Reasoning that persons with ineffective problem-solving skills would have difficulties adhering to their health and self-care needs following SCI, Herrick, Elliott, and Crow (1994) found ineffective problem-solving abilities significantly characteristic of those diagnosed with at least one pressure sore in the year following psychological assessment. A subsequent study using a prospective design found that social problem-solving abilities assessed during inpatient rehabilitation did not significantly contribute to the prediction of pressure sore occurrence assessed in the 1st annual outpatient evaluations after SCI onset (Elliott, 1999).

Unfortunately, the empirical study of pressure sore occurrence following SCI is compromised by small sample sizes, cross-sectional designs, poor or unknown interrater reliability, and low statistical power (Consortium for Spinal Cord Medicine, 2000). Many persons do not attend routine outpatient clinic appointments: Patients and families report that transportation and mobility problems prevent individuals from attending annual outpatient evaluations (Canupp, Waites, DeVivo, & Richards, 1997). Pressure sore incidence ranges from 22% to 59% during acute care and rehabilitation and 20% to 30% in the first 5 years following SCI onset (Stover et al., 1995; Yarkony & Heinemann, 1995). A significant minority of individuals with SCI are thus at risk for pressure sore development in the initial years of SCI, but the relatively low total number of persons returning for annual outpatient evaluations compromises the statistical power necessary to test predictive models. For sufficient power, a longer period of time and multiple evaluations are required.

We conducted the present study to test the hypothesis that social problem-solving abilities would be prospectively predictive of pressure sore occurrence over the first 3 years of SCI. Persons with recent-onset SCI were evaluated at discharge from an inpatient SCI rehabilitation program, and pressure sore occurrence was assessed in annual outpatient evaluations over the following 3 years. The prospective design and the time frame for repeated pressure sore evaluations improve upon previous research. A predictive model then tested the presumed relationship between problem-solving abilities and pressure sore occurrence within the context of several clinically important demographic and injury-specific variables.

Method

Participants

Participants admitted to an inpatient SCI rehabilitation unit were consecutively referred for psychological assessment (from 1993 through
Prior to discharge from the unit, patients were seen for a second assessment to assist in postdischarge planning and consultation. Persons who completed this second assessment were included in the present study. Although these assessments were part of routine clinical practice, participation was optional. Following discharge, individuals could continue their clinical care in the outpatient clinics as part of their participation in the SCI Model Systems project conducted at the hospital.

Basic demographic information for the participating sample is contained in Table 1. All persons included in this study had incurred SCI within a year of assessment (range of time since injury onset: 1–52 weeks [M = 6.50 weeks]). One hundred and eighty-eight persons (143 men, 45 women) participated in the discharge assessment; 149 persons (111 men, 38 women) did not participate in the discharge assessment. Although there were no systematic reasons recorded to account for those who did and did not receive this assessment, several interesting differences were observed between these two groups. Persons who participated in the discharge assessment were significantly younger (M = 31.91 years, SD = 12.39) than persons who did not participate (M = 42.64 years, SD = 18.49), p < .001. There were more persons who incurred SCI in motor vehicle accidents among those who completed the assessment (n = 104) than among those who did not (n = 50). Persons who did not participate in the discharge assessment had a higher incidence of disease-onset SCI (n = 37) than those who did complete the assessment (n = 10). There were more persons with complete lesions among those who did participate in the discharge assessment (n = 102) than among those who did not (n = 50). There were no significant differences between the two groups by gender, level of SCI, or race. These data suggest that those in the group that completed the discharge assessment were more representative of persons with SCI who typically participate in the Model Systems database, because their demographic information approximates that often reported for persons who qualify for this project.

Persons were admitted to the SCI inpatient treatment program following a diagnosis of SCI and recommendation of a physiatrist. Individuals who were diagnosed by the admitting physiatrist as having a coexisting head injury were referred to the inpatient traumatic brain injury program; therefore, individuals with a diagnosed brain injury and SCI were not a part of this psychological assessment. Nevertheless, in the initial psychological assessment, patients were asked if they experienced a loss of consciousness at the time of SCI onset, and the medical record was reviewed for any report of loss of consciousness (LOC). One hundred and three persons reported no LOC, and there was evidence that 83 persons experienced some LOC at the time of injury (LOC status was not recorded for 2 participants). The sample included 99 persons with a diagnosis of paraplegia and 89 with tetraplegia; 87 had incomplete lesions to the spinal cord, and 101 had complete lesions.

### Measures

**Social problem-solving abilities.** The Social Problem-Solving Inventory—Revised (SPSI–R; D’Zurilla, Nezu, & Maydeu-Olivares, 2002) is a 52-item self-report measure of social problem-solving abilities. Each item is rated on a 5-point Likert-type scale ranging from 0 (not very true of me) to 4 (extremely true of me). The SPSI–R is based on a 5-dimensional model of problem solving and includes five scales (D’Zurilla & Nezu, 1999). Two of the SPSI–R scales measure problem-orientation dimensions: Positive Problem Orientation and Negative Problem Orientation. The remaining three scales are considered problem-solving skills scales: Rational Problem Solving, Impulsive/Careless Style, and Avoidant Style.

The Positive Problem Orientation (PO) scale assesses a general cognitive set that includes the tendency to view problems in a positive light, to see them as challenges rather than threats, and to be optimistic regarding the existence of a solution and one’s ability to detect and implement effective solutions. The Negative Problem Orientation (NO) scale assesses a cognitive–behavioral set that hinders effective problem solving. The Rational Problem-Solving (RPS) scale assesses the tendency to systematically and deliberately use effective problem-solving techniques that include defining the problem, generating alternatives, evaluating alternatives, implementing solutions, and evaluating outcomes. The Impulsive/Careless Style (IC) scale measures a tendency to implement skills in an impulsive, incomplete, and haphazard manner. The Avoidant Style (AV) scale assesses the degree to which a respondent ignores a problem, procrastinates, and waits for a problem to resolve spontaneously.

Internal consistency estimates (alphas) for the scales in a sample of college students ranged from .76 (PO) to .92 (RPS), and test–retest (3 weeks) reliability ranged from .72 (PO) to .88 (NO; D’Zurilla et al., 2002). Criterion-referenced validity is evidenced by significant correlations with relevant scales on the SPSI–R (Heppner, 1988) and with such other theoretically related constructs as stress, somatic symptoms, anxiety, depression, hopelessness, and suicidality (D’Zurilla et al., 2002). The SPSI–R scales have been predictably associated with self-esteem, life satisfaction, extraversion, social adjustment, and social skills (Nezu, 2004).

**Pressure sore diagnosis at annual evaluations.** The presence of any pressure sore was determined by the physiatrist who conducted the yearly medical evaluation of a returning participant. These sores were diagnosed by visual inspection in a manner consistent throughout the cooperating Model Systems centers (Enis & Sarmiento, 1973). Although pressure sores can be rated in terms of severity, for our purposes it was sufficient to code pressure sores as absent (coded as 0) or present (coded as 1) in any number and regardless of severity. This coding scheme has been used in previous studies of predictors of pressure sore occurrence among community-residing persons with SCI (Elliott, Kurylo, Chen, & Hicken, 2002; Garber, Rintala, Hart, & Fuhrer, 2000; Herrick et al., 1994). All participants in the study returned at least once for a pressure sore evaluation. Pressure sore diagnostic data were available for 179 individuals at the first annual evaluation, for 141 individuals at the second annual evaluation, and for 109 individuals at the third annual evaluation.

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**Table 1**

**Demographic Characteristics of the Sample**

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Note. N = 188. Time since injury onset (weeks): M = 6.50, SD = 6.33.
Data Analysis

We performed longitudinal analysis using a generalized estimating equation (GEE; Diggle, Liang & Seger, 1994) to examine the relation of social problem-solving abilities to pressure sore occurrence. We recorded an individual’s pressure sore status on a yearly basis for up to 3 years in this study. These observations obtained at multiple points in time from the same participants were likely to be positively correlated. The GEE procedure is able to handle the repeated measurements and was therefore chosen to adjust for the potential dependence within the same participants across observations. This technique is also robust regardless of the variability in the number of observations per participant.

The univariate GEE approach consisted of the calculation of crude odds ratios (ORs) and 95% confidence intervals (CIs) for all potential risk factors for pressure sores. The OR is an estimate of the likelihood of pressure sore occurrence for persons characterized by one attribute of a variable (e.g., Caucasian) relative to those persons characterized by the referent attribute of the same variable (e.g., African American). An OR of 1.00 suggests that there is no relation for that particular variable with pressure sore occurrence. An OR greater than 1.00 implies an increased risk, whereas an OR less than 1.00 implies a decreased risk. The 95% CI around an OR is used to measure the precision and statistical significance of the OR estimate. Clinical risk factors often considered in pressure sore risk include race, age, completeness of lesion, level of injury, and gender (Yarkony & Heinemann, 1995). These were included in our GEE analysis. Years of SCI duration, years of formal education, and LOC recorded at admission to the inpatient program were also included.

The multivariate GEE approach was used to assess the impact of problem-solving abilities on pressure sore occurrence after adjusting for the potential confounding effects of other risk factors. Potential confounding variables were selected on the basis of prior clinical knowledge and a backward stepwise procedure. We included all factors as a full model and systematically eliminated as nonsignificant factors during the backward stepwise procedure included race, education, level of injury, and LOC; consequently, no multivariate information is presented in Table 3 for these variables.

The final multivariate GEE model contained age, gender, completeness of lesion, and years postinjury as predictor variables. After controlling for the potential confounding from other risk factors, we observed a continuous increase in pressure sore occurrence with increasing age (p = .03). Pressure sores were observed more frequently during the 1st year and decreased in frequency in subsequent evaluations. The odds of pressure sore occurrence were 1.62 times higher for men (p = .08) and 2.40 times higher for persons with a complete lesion (p = .001).

Table 2
Means, Standard Deviations, and Correlations for Variables Used in Subsequent Analyses

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Note. PO = Positive Problem Orientation (potential range: 0–20; observed range: 5–20); NO = Negative Problem Orientation (potential range: 0–40; observed range: 0–32); RPS = Rational Problem-Solving (potential range: 0–80; observed range: 7–79); IC = Impulsive/Careless Style (potential range: 0–80; observed range: 0–28); Level = level of spinal cord injury (SCI) severity (coded as 0 = paraplegia, 1 = tetraplegia); Lesion = completeness of spinal cord lesion (coded as 1 = incomplete, 2 = complete); LOC = loss of consciousness reported at SCI onset (coded as 1 = no, 2 = yes); Race = race of participant (coded as 1 = Caucasian, 2 = African American); Gender = gender of participant (coded as 1 = male, 2 = female); Age = age at time of initial assessment (in years); Educ = years of formal education; Sore 1 = pressure sore diagnosis at 1st-year assessment (coded as 0 = negative, 1 = positive); Sore 2 = pressure sore diagnosis at 2nd-year assessment (coded as 0 = negative, 1 = positive); Sore 3 = pressure sore diagnosis at 3rd-year assessment (coded as 0 = negative, 1 = positive).

Results

Means, standard deviations, and correlations among the variables used for comparative purposes and in subsequent analyses are presented in Table 2. The potential risk factors for pressure sore occurrence identified by the univariate GEE analysis are summarized in Table 3. Reference groups for several variables were coded as 0 and had a crude OR of 1.00 (i.e., African American race, incomplete lesion, paraplegia, female gender, 1st year of injury, and without LOC were each coded as 0 for comparative purposes in the GEE equation). Variables that were systematically eliminated as nonsignificant factors during the backward stepwise procedure included race, education, level of injury, and LOC; consequently, no multivariate information is presented in Table 3 for these variables.
pressure sore occurrence was inconsistent with our theoretical understanding of the social problem-solving model. Specifically, PO significantly contributed to the model, but the direction of the relationship indicated that the likelihood of pressure sore occurrence increased by 11% with each single point increase on the PO scale (OR = 1.11; 95%, 95% CI = 1.00–1.24).

A positive orientation is vital in the problem-solving process in that it serves to assist in emotional regulation and in providing motivation for effortful problem solving. PO is understandably correlated with RPS (r = .68); theoretically, a positive problem orientation motivates an individual toward the effortful task of rationally solving problems. Yet there is some concern that the GEE results may reflect some artifact of shared measurement error between these two scales. Moreover, prior research has found similar anomalies with the positive orientation variable in the prediction of objectively defined outcomes. For example, a component of the positive orientation variable was associated with a greater likelihood of a diagnosed urinary tract infection among persons with SCI who varied considerably in the time since the onset of injury (Herrick et al., 1994), and this component was unexpectedly characteristic of persons who failed to observe a mandated outpatient clinic visit among persons receiving treatment for dually diagnosed disorders (Herrick & Elliott, 2001).

**Secondary Analysis**

Therefore, we conducted a second analysis that would permit greater scrutiny of the relationships that might exist between the predictor variables. We used a structural equation model to evaluate a path analysis of the hypothesized relationships between these constructs (using AMOS 5.0; Arbuckle, 2003). Path analysis has several advantages over other forms of data analysis. Path analysis is a form of structural equation modeling that allows for the evaluation of the indirect and direct relationships among variables. This analysis is similar to conducting several separate multiple regressions in one analysis, with one important difference: The relationships among all of the variables are tested at one time, providing a clearer picture of the relationships among these constructs in their prediction of (in this case) pressure sore occurrence. The relationships among the latent variables produce path coefficients. Inspection of path coefficients is similar to inspection of multiple regression results. In path analysis, however, the regressions are run simultaneously, allowing for a more parsimonious evaluation of the complex associations and potential causal relationships among variables.

The variables used in path analysis include observed variables (the data gathered) and latent constructs (comprised of multiple variables) which are the actual constructs under study. Path analysis allows for the evaluation of how well the collected data fit the hypothesized model (Byrne, 1989). In this study, the latent constructs included demographic characteristics, injury severity, problem-solving abilities, and pressure sore occurrence. The latent variable demographic characteristics was measured using the observed variables of age, race, gender, and education. Injury Severity comprised lesion completeness, LOC, and SCI level. Problem-solving abilities comprised respondent scores on the SPSSI–R, including PO, NO, and the IC, RPS, and AV subscales. Finally, pressure sore occurrence as a latent variable was measured by the presence or absence of pressure sores during each of the 3 years of the study.

As is usual in structural equation modeling, we used multiple goodness-of-fit measures to evaluate the model, because each addressed different aspects of model fit (Bollen & Long, 1993; Byrne, 1989; Long, 1983; Marsh, Balla, & McDonald, 1988). This study used goodness-of-fit indices including the ratio between the (minimum-discrepancy) chi-square value and its degree of freedom (CMIN/df), the incremental fit index (IFI; Bollen, 1989a), the
Tucker–Lewis coefficient (TLI; Bollen, 1989b), and the comparative fit index (CFI; Bentler, 1990). The IFI, TLI, and CFI range from 0 to 1, with fit indices greater than .90 indicating good fit between the collected data and the proposed model. The CMIN/df ratio reflects the chi-square statistic divided by the degrees of freedom. CMIN/df values that indicate adequate fit of the data to the model typically range from 2:1 to 3:1, with smaller ratios indicating a better fit (Carmines & McIver, 1981). The amount of error variance in the model is reflected in the root-mean-square error of approximation (RMSEA); values less than .05 are considered adequate (Browne & Cudeck, 1993). Although the chi-square and associated significance value (p) are usually not used in evaluating model fit, a p value greater than .05 is desirable, because it reflects that there is no significant difference between the proposed model and the measured data.

On the basis of prior clinical and empirical work, the model in this study hypothesized that demographic characteristics and injury severity would influence problem-solving abilities, and pressure sore occurrence would be predicted by problem-solving abilities. Demographic characteristics were hypothesized to be positively associated with injury severity (on the basis of epidemiological research). It is possible that some combination of education, age, LOC, or complete lesion may influence the self-report of problem-solving abilities, and thus we tested direct paths from the demographic characteristics construct and the injury severity construct to the problem-solving abilities construct. Once these associations were taken into account, it remained possible that social problem solving would exert a significant path to pressure sore occurrence, and demographic variables might be directly related to pressure sore occurrence. Other research has found that demographic variables contribute to both injury severity and cognitive functioning in persons with traumatic brain injury (Bush et al., 2003; Novack, Bush, Meythaler, & Canupp, 2001). These studies found that cognitive functioning had a significant impact on important outcomes (e.g., return to work, disability status) at 1 year, whereas demographic variables and injury severity did not. In our analysis, then, we tested the possibility that problem-solving abilities would exert a greater influence on pressure sore development than would demographic characteristics and disability-specific information once all of these predictor variables—and the relationships among the constructs—were examined simultaneously in the prediction of pressure sore occurrence.

Because the current model theoretically paralleled the model tested and confirmed by Bush et al. (2003), the path coefficients between each endogenous variable were fixed in the proposed a priori model, resulting in goodness-of-fit indices that tested the hypothesized relationships between the constructs.

**Results of Secondary Analysis**

Figure 1 displays the hypothesized model and resulting path coefficients. The data were evaluated for skewness, kurtosis, and Heywood cases and found acceptable. The resulting model provided a good fit to the data (CMIN = 155.32, CMIN/df = 1.186, IFI = .94, TLI = .95, CFI = .94, p = .07). The model accounted for a high degree of error variance (RMSEA = .032).

For the model evaluated, the demographic characteristics significantly influenced both problem-solving abilities (.68) and injury severity (.28). Examination of regression weights and maximum-likelihood estimates for specific variables contributing to these constructs indicated that age was the strongest contributor to the demographic construct (estimate = -.439, p < .05) and accounted for 19.3% of the variance in this latent construct. In contrast, education accounted for 13.7% of the variance, gender accounted for 3.2% of the variance, and race accounted for 0.6% of the variance. As hypothesized, demographic characteristics were not directly associated with pressure sore occurrence (path coefficient = .04), but they were significantly associated with pressure sore occurrence through the mediating construct of problem-solving abilities.

Figure 1. Path model predicting pressure sore occurrence in the first 3 years of spinal cord injury. Bolded path coefficients reflect significant paths. * p < .05.
was contrary to our initial GEE analysis and demonstrates the
value of considering all study variables at once.

As predicted, injury severity was significantly negatively (−.48)
associated with problem-solving abilities, but the path to pressure
sore occurrence was not significant (−.06). LOC appeared to have
a greater contribution to the injury severity construct \( R^2 = .934, p < .05 \). Lesion completeness \( R^2 = .111 \) and SCI level \( R^2 = .066 \) did not significantly contribute to the construct or, by exten-
sion, to the model. These data imply that the indication of LOC at
injury onset may have been associated with ineffective social
problem-solving abilities in this predictive model.

The problem-solving abilities construct was causally associated
with the occurrence of pressure sores across the 3 years (−.67); ineffectual problem-solving abilities were associated with a higher
number of pressure sore occurrences. Inspection of the standard-
ized regression weights revealed that all five problem-solving
variables contributed to the occurrence of pressure sores. Higher
PO (−.228) and more RPS style (−.245) were associated with
fewer pressure sores, and higher NO (.894), IC style (.736), and
AV style (.725) were associated with the occurrence of pressure
sores. It is interesting to note that of the five social problem-
solving variables, only PO and RPS skills evidenced a significant
degree of covariance (estimate = 36.51, \( p < .05 \)), suggesting that
these variables had a significant degree of shared error variance
(which might reflect measurement error).

Discussion

The present study indicates that cognitive–behavioral charac-
teristics may be predictive of pressure sore occurrence in the first
3 years of SCI and that these characteristics may have considerable
clinical impact on pressure sore development. Constructive ele-
ments of the social problem-solving model were predictive of
pressure sore occurrence in both analyses. Although clinical guide-
lines emphasize the importance of behavioral risk factors in the
development of pressure sores following SCI and recommend
teaching individuals how to prevent pressure sore occurrence, the
present work is among the first to provide empirical evidence
connecting cognitive–behavioral characteristics with pressure sore
occurrence. Moreover, social problem-solving abilities are embed-
ed within a theoretical framework that provides clear directives
for prevention programs and psychological interventions.

Prior anecdotal observations and empirical research has influ-
enced current conclusions regarding the role of disability severity
in pressure sore development among persons with SCI (Krause,
1996). To a great extent, this research has eschewed the study of
meaningful psychological constructs in the prediction of pressure
sores. This is a salient point in light of the considerable evidence
concerning the effectiveness of cognitive–behavioral interven-
tions, generally, in rehabilitation psychology (Elliott & Jackson,
2005). Our secondary analyses suggest that disability severity—
and other demographic and condition-specific characteristics that
are rather immutable to potential intervention—may have less
predictive value once cognitive–behavioral characteristics are
taken into account. Alternatively, our secondary analyses imply
that disability and demographic variables may exert a very differ-
ent influence in the development of pressure sores once psycho-
logical constructs are considered. Thus, neither demographic nor
disability-specific variables directly contributed to the prediction
of pressure sores once certain cognitive–behavioral variables were
taken into account. The influence of demographic characteristics
on pressure sore development was mediated by social problem-
solving abilities. To a great extent, the study of secondary com-
lications following physical disability has emphasized the study
of atheoretical, descriptive examinations of demographic variables
and condition-specific characteristics while neglecting the rigorous
study of psychological constructs that offer clear directions for
intervention and prevention (Elliott & Rivera, 2003).

In contrast, previous research has demonstrated that social
problem-solving interventions can be effective in alleviating distress
among persons with cancer (Nezu, Nezu, Felgoise, McClure, &
Houts, 2003) and in improving coping and self-regulation skills
among persons with neurocognitive impairments (Rath, Simon,
Langenbahn, Sherr, & Diller, 2003). Problem-solving interven-
tions can be effectively provided in brief individual sessions in
primary-care settings (Mynors-Wallis, Gath, Lloyd-Thomas, &
Tomlinson, 1995) and in community-based telephone sessions
with community-residing adults (Grant, Elliott, Weaver, Bar-
tolucci, & Giger, 2002). The benefits of problem-solving training
often include an increase in self-appraised (Grant et al., 2002) and
observed problem-solving abilities (Rath et al., 2003). However,
research to date has not systematically examined the effectiveness
of problem-solving interventions in SCI rehabilitation. In one
relevant study, persons who had recently experienced surgical
repair for a severe pressure sore did not report any benefits from
individual problem-solving training conducted at their bedside
(Shamhugham, Elliott, & Palmatier, 2004).

It is important to note that the results of the present study do
dnot specify how effective problem-solving abilities influence
behavior that might result in a decreased risk for pressure sore
development. Effective problem-solving abilities are associated
with an array of adaptive personal and social characteristics that
could enhance personal health and prevent secondary compli-
cations (e.g., effective interpersonal skills, meaningful social
relationships, active coping efforts; Nezu, 2004). The results
from our initial analysis support earlier arguments that the
problem-solving skills component of the social problem-solving
model might be uniquely predictive of outcomes that are med-
diated by behavioral pathways (Elliott et al., 1995). From this
perspective, persons with ineffective problem-solving skills—
as assessed by the NO, AV, and IC scales of the SPsI—may
be at risk for pressure sore development because they are more
likely to have sedentary lifestyles, report more health-compromis-
ning behaviors, and have fewer goal-directed activities than
are persons with effective problem-solving skills.

Alternatively, there is also evidence that all of the various elements
associated with effective problem-solving may be instrumental in the
adjustment of persons with chronic health conditions: Persons who
live optimally with chronic health conditions must be able to cope
effectively with multiple stressors that can require the application of
different techniques to handle minor problems, monitor changes in
mood, meet routine life demands, and adhere to behavioral regimens
(Elliott et al., 2004). Thus, the full array of social problem-solving
abilities can exert a positive influence on therapeutic adherence
through its mediating effects on stress, emotional distress, and psy-
chological health generally (including social support and positive
states of mind; Johnson, Elliott, Neilands, Morin, & Chesney, in
press).
Limitations

Several limitations of this study should be considered. Data were collected from individuals who were admitted to a single rehabilitation center, and by extension, these persons were representative of a group of individuals from a particular catchment area who would be eligible and admitted for services at this one center. Other rehabilitation hospitals have greater diversity among their clientele across several important dimensions, and we do not know the degree to which other unmeasured variables may alter our findings. Therefore, we do not know the degree to which these findings may generalize to other settings. Our findings may be limited to this particular sample and to the specific time frame in which these data were collected. Many individuals did not participate in the second psychological assessment, and others did not return for outpatient evaluations. We do not know the degree to which this may have affected our results. We relied on a dichotomous coding of the pressure sore evaluations, and we do not know the degree our lack of information concerning the severity and number of pressure sores at each evaluation may have influenced our results.

Implications

Individuals who have severe secondary complications (like pressure sores) may have multiple and complex problems. Some problems may not be within the realm of personal volition per se, and in some situations, individuals may have difficulty identifying, articulating, and prioritizing their problems or being cognizant of the ways in which unresolved problems may contribute to other problems (e.g., loneliness, social isolation, decreased mobility). Individuals typically make health-care choices and decisions about medical concerns on the basis of their unique life situations and personal issues, but these reasons may not be obvious to rehabilitation personnel. It may be critical to enhance problem-identification skills among persons with multiple health problems so that individualized problem-solving training may be tailored to meet the needs of each person. To expedite skill building and to increase relevance, it may be necessary to use assessment techniques that help participants identify and prioritize their problems and to eschew packaged, standardized protocols that are insensitive to a person’s unique stressors and circumstances. Furthermore, it may be important to identify persons at risk, taking into account their problem-solving abilities, so that strategic and community-based interventions may be provided to those individuals who are at high risk for pressure sore development following discharge from an inpatient setting. Prevention programs can incorporate a problem-solving approach to emphasize proactive coping skills and health-promoting behaviors.

It is important to note that our initial analysis supported previous research concerning demographic risk factors for pressure sore development. In this respect, our results are consonant with the existing literature. The significant contribution of PO to the equation may have been an artifact of shared measurement error between the RPS scale and the PO scale. Our secondary analyses revealed a different pattern of relationships among the various endogenous variables, suggesting that results from studies of pressure sore occurrence may vary in part as a function of data-analytic strategies. These findings indicate that greater consideration of specific data-analytic options is warranted in this area of research, because certain techniques may be more suitable for testing psychological theories in an a priori fashion. Psychological constructs embedded in theoretical frameworks should be included in models to predict secondary complications associated with SCI. These variables may afford a more sophisticated appreciation of the possible mechanisms that contribute to the development of pressure sores over time than that offered by the study of immutable demographic and condition-specific characteristics.

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